Vol. XVI. Part I. March, 1943.

THE TEA QUARTERLY

THE JOURNAL OF THE TEA RESEARCH INSTITUTE OF CEYLON

Edited by

ROLAND V. NORRIS, D. Sc., F.I.C.,
Director, Tea Research Institute.

THE TEA RESEARCH INSTITUTE,
St. Coombs, Talawakelle.

H. W. CAVE & CO., COLOMBO.

The Tea Research Institute of Ceylon.

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NOTE.

The Laboratories of the Institute are situated at St. Coombs Estate, Talawakelle, and letters and enquiries should be addressed to the Director, Tea Research Institute of Ceylon, St. Coombs, Talawakelle. Telegraphic Address:—Research, Talawakelle; Telephone, Talawakelle 44 (Private Exchange). It is particularly requested that letters should not be addressed to officers by name.

FERTILISER RATIONING AND DISTRIBUTION

INTERIM REPORT

This report covers the activities of the me up to the end of the 1st Distribu Quarter, *i.e.*, up to the middle of ruary.

The uncertain position in regard to liser stocks and future arrivals in on of manures, together with difficul- which had arisen in connection with rnal transport, made it obvious in the mn of 1942 that steps would have to aken to ration issues of fertilisers and rganise a system of delivery in order all estates might receive their fair appropriate share of whatever ferti- s might be available.

At the Meeting of the General Com- ee of the Planters' Association of on held on 18th September, 1942, I was d to act as Organiser of such a scheme. nall Committee, under the Chairman- of Mr. R. C. Scott, and consisting of esentatives of the Planters' Association ylon, Ceylon Estates Proprietary Asso- on, the Fertiliser Firms and myself and T. E. H. O'Brien representing the Tea arch Institute and Rubber Research me, respectively, was set up to work he necessary preliminary details The osals after very full consideration by oncerned, including special meetings isiting Agents representing both the nd rubber industries, were approved e Ceylon Estates Proprietary Associ- and the Planters' Association of n, and I was authorised on the 11th mber, 1942, by the Emergency Com- e of the Planters' Association to ed with the scheme. Preliminary steps in anticipation of such sanction had already been taken by me and deliveries of rationed manure in fact began on the 16th November.

In brief the basis of the scheme is as follows :—

(1) The scheme is a voluntary one and is not restricted to members of the Planters' Association of Ceylon and Ceylon Estates Proprietary Association, but applies equally to all persons requiring fertilisers for the production of tea and rubber and the figures given later will show that this provision has been fully implemented.

(2). The quotas issued cover estate allotments for twelve months dating from 1st October, 1942. As deliveries of rationed manure necessarily only began at a later date any manure received by estates outside the ration issues, after October 1st in the case of tea and November 16th in the case of rubber, count against the quotas Such deductions are calculated in terms of the weight of standard mixture equivalent in nitrogen content to the manure actually delivered to the estate.

(3). *Rationing.*—Persons requiring manure were required to complete a form giving details of the acreage under cultivation and in the case of tea the standard assessment of the estate and the actual crop harvested for the twelve months ending 30th September were also tabulated, standard assessments being checked against figures supplied by the Tea Controller. Fertiliser permits were then issued by the Organiser, Fertiliser Ration-

ing, to all applicants on the following basis :—

(i) *Tea.*—The nitrogen allowance is on a sliding scale based on the productive capacity of the estate, ranging from an allowance of 10 lbs. per acre on a crop of 200 lbs. per acre to a maximum of 42 lbs. per acre on crops of 1,300 lbs. and over per acre. "Crop" is defined to be the Standard Assessment of the estate or the actual crop (excluding bought leaf) produced in the twelve months ending 30th September, 1942 whichever is the higher.

As figures based on Standard Assessments had already been classified, in order to avoid delay in starting the scheme, the original permits were all issued, and distribution in the 1st quarter made, on this basis, but such permits have since been revised in the case of all estates entitled to an increased quota on actual crop.

All tea permits have been issued in terms of a standard 500 pound mixture (T500) made up as follows :—

(T500)

Groundnut cake	430 lbs.
Saphos phosphate	60 ,,
Muriate of potash	10 ,,
	500 lbs.

giving Nitrogen 30 lbs., Phosphoric acid 17.7 lbs. and Potash 6 lbs.

Permits have also been issued for seed-bearer areas on the basis of 48 lbs. nitrogen, or 800 lbs. standard mixture, per acre,

(ii) *Rubber.*—Strictly speaking rubber manure is not rationed in so much as estates receive the full amount of manure considered by the Rubber Research Scheme and the Consultative Committee to be necessary for full production. The basis of distribution is as follows :—

Mature Rubber (over 7 years). —Allowance is made for the manuring annually of half the acreage of mature rubber at the rate of 400 lbs. per acre of the following standard mixture, (R400) or the equivalent in sulphate of ammonia if estates so prefer.

(R.400)

Ammonium sulphate	290 lbs.
Saphos phosphate	90 ,,
Muriate of potash	20 ,,
	400 lbs.

giving Nitrogen 59.74 lbs. Phosphoric acid 26.55 lbs. and Potash 12.0 lbs.

Young Rubber.—Provision is made for the manuring of the whole area on the basis of 215 lbs. per acre of standard mixture (R215) for half the acreage plus 100 lbs. per acre of Saphos phosphate on half the acreage.

(R215)

Ammonium sulphate	100 lbs.
Saphos phosphate	100 ,,
Muriate of potash	15 ,,
	215 lbs.

giving Nitrogen 20.6 lbs., Phosphoric acid 29.5 lbs. and Potash 9 lbs.

This ration is based on the assumption that the average age of the young rubber may be taken at 3½ years. Where such an age average is exceeded estates may claim an extra allowance. Cases of this sort and any other special applications are referred to the Director of the Rubber Research Scheme for scrutiny and I am much indebted to Mr. O'Brien for his assistance in such matters.

(iii) *Coconuts.*—Rationing does not apply and no permits are required provided demands are restricted to normal requirements. In determining the basis of rationing for tea and rubber care was taken to see that adequate supplies of fertilisers were left available to meet the requirements of coconut estates.

(4) *Fertiliser Control Bureau.*—From the first it was realised that fertiliser distribution could only be successfully carried out by the adoption of standard mixtures and by the setting up of a central organisation in Colombo to serve as a clearing house for all permits, receive and distribute all orders between the individual Fertiliser Firms, and arrange for the regulated issues of manure in accordance with the quotas laid down for each distribution quarter by the Organiser, Fertiliser Rationing. The Fertiliser Firms readily agreed to the setting up of the above organisation. the Fertiliser Control Bureau. which has worked with great smoothness and enormously simplified the whole process of rationing and distribution.

A uniform price has been fixed for all the standard mixtures and estates have to agree to receive manure from any of the three firms concerned

The thanks of the tea and rubber industries are due to the Fertiliser Firms for pooling their resources in this way and so making the scheme possible and in particular to the three gentlemen, Mr. A. Brown Mr. T. K. Anderson and Mr W. R. Thomson who have at different times been in charge of the Fertiliser Control Bureau and have done everything, possible and impossible, to promote the success of the scheme.

(5). *Distribution.*—The number of waggons available for fertiliser distribution by rail has been sufficient to deal with only a proportion of the tonnage to be transported. It was therefore necessary to arrange for certain districts to be served by lorry only. The division thus made may have appeared to some somewhat arbitrary: actually it was made only after very full discussion with the transport authorities. the principle being that waggons should be used for the longer haulages and. in particular. that wear and tear of lorries and tyres and petrol consumption should be reduced as far as possible by restricting the use of lorries on the hilly roads up-country In practice therefore distribution has been effected as follows :—

By C. G. R. Main Line.—Uva, Nuwara Eliya. Dimbula. Dickoya Dolosbage-Kotmale and Pussellawa Districts. use of waggons being restricted to stations Gampola and above.

By C. G. R. K.V. Line.—Sabaragamuwa and certain estates in the K. V. District.

By Lorry Service.—All other areas.

In the case of the Main Line all waggon allocations and dates of despatch

are arranged by the Organiser, Fertiliser Rationing, schedules are then completed in the Fertiliser Control Bureau showing the tonnage to be distributed to individual estates by each train and such schedules are issued to Station Organisers appointed by District Planters' Associations to act as controllers at each station to which fertilisers are despatched. The Station Organisers advise estates as to when manure will arrive, organise local lorry transport from rail-head to estate, ensure the rapid unloading of waggons and if possible arrange for return loads of tea or rubber.

Thanks to the willing and effective work of the Station Organisers the scheme has on the whole worked most smoothly and estates have regularly received their quotas in accordance with the delivery schedules.

K. V. Line.—This has been worked on the same principle but here waggon allocations are made by the local organiser, Mr. W. J. Craig of Pelmadulla Group, who originally organised fertiliser deliveries by this line, such allocations being made on the basis of the quarterly quota figures supplied by the Organiser, Fertiliser Rationing. I am greatly indebted to Mr. Craig for agreeing to continue this work.

Lorry Service.—Here again Organisers have been appointed by local Planters' Associations for each district. Quarterly quota schedules are supplied to them by the Organiser, Fertiliser Rationing, and distribution schedules are issued by the Fertiliser Control Bureau. Conditions vary somewhat in different areas but, in general, the District Organisers' main task is to organise and control the lorry service for the collection of manure from Colombo and its distribution to estates and to see that return loads are provided so that lorry capacity is not wasted. In the larger areas, particularly in those where many less organised estates and small-holdings participate in the scheme, the work of District Organisers is heavy and has been very much appreciated.

To offset to some extent the extra cost of lorry transport as compared with railway rates, a more concentrated manure mixture, T430, has been utilised in the case of tea for lorry served areas. This mixture of course supplies the same amount of plant food as the T500 mixture and the cost of such plant food is the same.

(6) *Statistics.*—The following statistics in regard to the scheme may be of interest, the data being complete up to the middle of February, the end of the first distribution quarter.

(i) *Permits.*—Number issued to 16th February is:—

	P. A. Members	Others	Total
Tea	767	237	1.004
Rubber	449	432	881
Total	1,216	669	1,885

Applications are still being received and the total number of permits for tea and rubber is likely to reach the 2,000 mark.

(ii) *Acreages for which permits have been issued* :—

Tea		430,654 acres
Rubber Mature	241,183 acres	
,, Young	48,150 ,,	289,333 ,,
	Total	719,987 ,,

(iii) *Tonnage to be transported* (12 months):—

Tea as T 500	55,200 tons by rail	
T 430	17,580 tons by lorry	72,780 tons
Rubber as R.400	18,935 tons	
Amm. Sulphate	1,671 ,,	
R.215	2,198 ,,	
Saphos	1,128 ,,	23,932 ,,
	Total	96,712 ,,

f the above total approximately 60,600 tons will be transported by rail and the alance by lorry.

(7). *Manure for Food Production.*—he issue of fertiliser permits for food roduction areas has, unfortunately been uch delayed by the very uncertain stock osition, particularly in regard to phosnoric acid, the available supplies of which ere much reduced by the requirements Government for paddy cultivation. ermits are however now being granted nd it is hoped nothing will materialise to nterfere with their issue.

(8) *Cost of Administration.*—A cess 25 cents a ton on all manure delivered nder the scheme is charged to estates by e suppliers and the proceeds credited to central fund maintained by the Fertiliser ontrol Bureau. From this fund the cost clerical assistance, stationery, printing, ostages, etc., incurred in the St. Coombs ffice and the expenses of District Organers will be met together with certain xpenditure incurred by the Fertiliser ontrol Bureau. Apart from the latter, expenses to 31st December, 1942, amounted to about Rs 2,500 and monthly expenses, excluding the Fertiliser Control Bureau, are not likely in future to be more than about Rs. 850. The accounts will in due course be submitted to the Ceylon Estates Proprietary Association.

(9). *Acknowledgments.*—I have already acknowledged my indebtedness to those who have been associated with me in the working of the scheme. I must however also express my thanks to Agency Firms and Superintendents who have willingly supplied all data required and have accepted the scheme and the inconveniences arising therefrom with much patience and forbearance. The scheme has so far worked without the least friction in any quarter and has I trust been of service to the industries concerned.

ROLAND V. NORRIS,
Organiser, Fertiliser Rationing.

SHOT-HOLE BORER AND WOOD ROT

C. H. GADD

E.H.N.

The Shot-hole borer beetle, *Xyleborus fornicatus fornicatior*, bores a gallery or tunnel within the living stems of tea bushes, and places on its walls a fungus, ambrosia, which later forms the food of the beetle and its young. The wood into which the gallery has been bored becomes stained and this discoloration is sometimes interpreted as the beginning of wood rot.[1]

Wood rot is a term used to describe the decay of the woody frame of a tea bush brought about by wood-rotting fungi which gain entry into the bush *via* pruning cuts and other wounds. The decay is often preceded by a discoloration of the wood.

An attempt[2] was made in 1935 to determine whether the discoloration around shot-hole borer galleries was also the beginning of a wood rot. The method then used was to isolate the fungi from the discoloured tissues around the shot-hole borer galleries, and to ascertain whether the fungi so isolated would cause decay of tea wood. The results were negative. Negative results are rarely satisfying because, as in this case, it might be argued that if other methods of isolation and other infested branches were used, one or more wood-rotting fungi might be found in the discoloured wood and so demonstrate that wood-rotting fungi, at least sometimes, gain entry into the frame *via* shot-hole borer galleries.

The results were also unsatisfactory in that they did nothing to explain a planter's observation that borer infested branches cut at one pruning were at the next pruning "found ruined with rot." Even if the above experimental evidence is accepted as conclusive that wood-rotting fungi only rarely gain entry into tissues of the bush *via* shot-hole borer galleries, a further possible explanation of the field-observation remains. It is that invasions of the wood *via* the galleries by fungi, other than those capable of causing direct decay, change the constitution of the wood in such a way as to render it more liable to invasion or to more speedy decay when attacked by wood-rotting fungi admitted through the cut when the branch is pruned. If this is the true explanation of the alleged increase of wood rot following shot-hole borer attack, it would be expected that the extent of rot in a given time after pruning would be greater in infested than in non-infested branches. The problem was, therefore, viewed from this angle, and an investigation was undertaken in the following manner.

Normally when a branch is pruned a new branch arises at, or a little distance away from, the pruning cut. At the end of a further pruning cycle, the new branch is cut back near its base; usually the new cut is at a given distance (often 4 inches) above the level of the previous one. For the purpose of this experiment a number of bushes at the end of a 3-year cycle were pruned; but instead of cutting them normally, the new cuts were made on the previously pruned stem three inches *below* the base of the branch which had grown during the last cycle. Those prunings which exceeded half-an-inch in diameter at

ne old pruning cut were removed for fur-
ner examination. Each "pruning" con-
sted of the branch which had grown
uring the cycle, together with at least 3
iches of the parent stem with a 3-year-old
runing cut exceeding half-inch in diameter
the upper end and a new cut at the
wer.

The piece of parent stem is important,
ecause it is in this stem that wood rot is
be expected. The fungi causing the rot
ay have gained entry at the first pruning
it or *via* shot-hole borer galleries occur-
ng in the stem. Any branches which had
her means of entry for wood rotting
ngi, such as wounds, were discarded

The remaining branches were then
lit longitudinally to determine whether
e branch contained shot-hole borer
lleries and to allow the measurement of
y wood rot present. From this exami-
tion the branches were classified as "with
ot-hole borer" and "without shot-hole
rer." These classes will be defined more
actly later.

Tea bushes are normally pruned to a
rel; the branches are not cut back to an
ye" or bud. It is, however, from the
permost healthy bud that the new branch
velops. Consequently, many branches
cut so that the uppermost bud which
er forms the new branch, is some appre-
ble distance below the cut. This piece
stem between the cut and the new
wing branch is useless to the bush; it
es out and is commonly known as "Die-
k." The length of dieback therefore
pends normally upon the distance a prun-
cut is made above the bud which
elops later into the new stem. Dieback
a natural consequence of pruning and is
due to the invasion of wood-rotting
gi.

It is therefore necessary to distinguish between Dieback and true Wood Rot resulting from the destruction of wood by fungi. The wood of a "dieback" is usually dry, brown and fairly hard but not friable. Dieback never extends below the uppermost new growth except occasionally on the side opposite the new growth. Wood rot is a penetration into "living" wood, usually heart wood, and it is characterised by the rot which makes the wood very friable. Separate measurements, to the nearest quarter inch, were therefore made of the length of dieback and of wood rot in each specimen.

It may be well to restate the problem at this stage. Does attack by shot-hole borer result in an increase of wood rot after the attacked branch is pruned? Any increase in the amount or extent of the wood rot may be due either to a wood-rotting fungus having gained early entrance into the stem *via* the borer's gallery, or to the wood having become more susceptible to rot as the result of the borer's activity. All the specimens had been equally liable to attack by wood-rotting fungi from external sources *via* the first pruning cut, for a period of three years. If then, attack by shot-hole borer has no effect on the wood rot which develops later, the same amount of rot would be expected in all branches. But if the borer in any way encouraged wood rot, more rot would be expected in those branches attacked by the borer before pruning.

The borer galleries which are of real importance are, therefore, those to be seen in the dieback and wood rot zones. Galleries in the otherwise healthy stem are of little importance. Consequently the specimens termed "with shot-hole borer" are those which had galleries either on the old cut

or within the dieback or wood rot zones. Specimens without galleries in such places were termed "without shot-hole borer," although one or more galleries may have been present in the otherwise healthy tissues

The shot-hole borer beetle shows a preference for entering tea stems at leaf scars [3] and in doing so frequently causes damage to the bud immediately above and so prevents it from breaking normally after the stem is pruned. This results in a

TABLE I

Length of *Dieback* in pruned stems with and without Shot-hole borer galleries.

Field	Pruning Cycle	With Shot-hole borer: No. of Specimens	With Shot-hole borer: Mean Diameter of stems	With Shot-hole borer: Mean length of Die-back	With Shot-hole borer: Standard error	Without Shot-hole borer: No. of Specimens	Without Shot-hole borer: Mean Diameter of stems	Without Shot-hole borer: Mean length of Die-back	Without Shot-hole borer: Standard error	Difference: Mean	Difference: Error
	Years		Inches	Inches	Inches		Inches	Inches	Inches	Inches	Inches
A	3	35	·71	0·76	·11	63	·72	0·41	·05	0·35	0·12
B	3	50	·79	0·99	·09	64	·86	0·54	·07	0·45	0·12
C	3	50	·79	0·75	·07	50	·81	0·27	·02	0·48	0·08

TABLE II

Length of *Wood-rot* in pruned stems with and without Shot-hole borer galleries.

Field	Pruning Cycle	With Shot-hole borer: No. of Specimens	With Shot-hole borer: Mean length of rot	With Shot-hole borer: Standard error	Without Shot-hole borer: No. of Specimens	Without Shot-hole borer: Mean length of rot	Without Shot-hole borer: Standard error	Difference: Mean	Difference: Error
	Years		Inches	Inches		Inches	Inches	Inches	Inches
A	3	35	1·1	·14	63	0·63	·09	0·43	0·17
B	3	50	0·22	·04	64	0·12	·03	0·10	0·05
C.	3	50	0·65	·10	50	0·33	·11	0·32	0·11

A summary of the measurements made by Mr. W. T. Fonseka at the Passara laboratories from specimens from three fields in the Passara district are given in Tables 1 and 2 :—

greater length of dieback of borer-infested branches. The figures given in Table 1 illustrate this fact although in neither of the fields was dieback very great. The die-back of borer infested branches was approxi-

ately twice as great as that of branches ot attacked by borer near the pruning cut.

Table 2 shows a similar result as egards wood rot. The amount of wood rot the three fields varied considerably but ie figures show that there was roughly bout twice as much wood rot in the borer-fested branches as in the non-infested. he differences observed are probably real id not due merely to chance. (A differ-ice of twice its standard error is accepted of statistical significance).

This experiment does not give any dication of a reason for the speeding up the wood rot attack. In view of the evious work, mentioned earlier, it is improbable that wood-rotting fungi normally gain entrance into the stem through shot-hole borer galleries. If that view is accepted it becomes evident that the wood around shot-hole borer galleries either is rendered more susceptible to attack or can be reduced to a friable condition more quickly by wood-rotting fungi after entry.

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DEFICIENCY DISEASES AND THE ROLE OF THE "MINOR ELEMENTS" IN PLANT LIFE

T. E. T. BOND

"The study of the nutrition of plants s been pursued during the last forty years th great zeal and excellent results. The mplete revolution which rational agricul re and forestry have experienced through e establishing of the theory of the nutri-n of plants, proves how much has been complished in this department. The most gnificant result of the development of the trition theory mentioned is met with . . . . . . in the fact that we are now able to ar plants artificially — that we are in a sition, with chemically pure water to nich we add some few chemically pure ts, to rear artificially highly developed nts . . . . . . — that from inconspicuous d often scarcely ponderable quantities of getable substance, quantities of it as large we choose may be produced in this way." us wrote Marshall Ward in the 1880's in his translation of Sachs' famous "Lectures on the Physiology of Plants." (12) And indeed the theory of plant nutrition as it was then established was revolutionary enough. In these days we can hardly realize the change in outlook that it implied Green plants were now known to depend for their food supply, not on the complex "organic juices" of the soil, but on such simple substances as the carbon dioxide of the atmosphere, water, nitrates, and certain inorganic salts in solution. Thus was inaugurated the age of artificial fertilizers — one might almost say the "NPK era" of agriculture — and, in more modern times, but in direct continuation of Sachs' water culture method, the revived and fashionable interest in soilless cultivation or "hydroponics," (7)

Unfortunately for modern agriculture, the "complete revolution" in agricultural practice that Sachs and his contemporaries viewed with so much, justifiable, satisfaction has had unforeseen consequences. One of the most significant of these (conditioned also by the increasing mechanisation of agricultural transport and machinery, and other economic changes) has been the rise to prominence of the deficiency diseases with the increasing recognition of the importance for plant nutrition of the so-called "Minor Elements."

The present article deals with a selection only of the various aspects of this recent development of the nutrition theory. Certain aspects which are not dealt with here, as for instance the more theoretical significance of the "Minor Elements" for plant metabolism, and their importance as affecting the health of the grazing animal, are briefly referred to in a review article on this subject reprinted in the *Tea Quarterly* for 1940 (Vol. XIII, pp. 148-152).

WHAT ARE THE "MINOR ELEMENTS"?

Sachs describes as necessary for the healthy development of his plants only "chemically pure water" with "some few chemically pure salts." In terms of the chemical elements involved his list of essentials, (*i.e.*, apart from carbon, hydrogen, oxygen and nitrogen) is a short one — "it is simply necessary that the nutritive mixture should contain the elements potassium, calcium, magnesium, iron, phosphorus, and sulphur, in suitable . . . . . combinations" — ten essential elements in all, of which three, namely, iron magnesium, and sulphur, are usually regarded as "Minor Elements" (possibly also calcium should be included here), since they are needed in small amounts relative to the plant's much larger requirements of nitrogen (N), phosphorus (P), and potassium (K). The fact that the list of essential "Minor Elements" is now quite rapidly being extended is due to improvements in technique and to our changed ideas of chemical purity. Water culture experiments, to be really critical, now demand some of the most elaborate and highly technical refinements of method to be found anywhere in agricultural research, although for certain purposes the simpler methods are still useful. The best authenticated of the recent additions to the list of essential elements are boron, manganese, copper, zinc, and molybdenum.[8], [2] Claims made with regard to some other elements are still open to doubt, while there may also be elements, including such well known ones as sodium, chlorine, and silicon, that are essential for certain plants only, but not for plant life in general.

By some authorities, the attempt is made to distinguish between *nutritional* elements, which are needed in relatively large quantities, or which are known to be required by the plant for direct incorporation into the tissues (as, for instance, magnesium enters into the composition of the green colouring matter, chlorophyll), and the so-called *stimulative, catalytic,* and *prophylactive* elements which fulfil other, less obvious functions. However, it seems likely that, in time, most of these will be found to have some direct nutritional significance, so that this distinction will disappear. The criteria of essentiality as given recently by the foremost American workers in this field [1] are worth noting. They are three in number, as follows:— (a) Deficiency must be shown to prevent the completion of the plant's normal life cycle; (b) It must be specific to the element in question, *i.e.*, an element is not essential if it can be replaced by another; (c) The element must be required by the plant itself, not merely on account of its effect on the chemical or biological equilibrium of the soil.

All the essential minor elements so far entioned have been shown to be deficient soils in various parts of the world and any different kinds of crops are known be affected. Various examples of deficiency diseases will be mentioned in the urse of this paper, although no attempt ill be made to include more than a small action of those already recognised.

WHAT QUANTITIES OF THE "MINOR ELEMENTS" DOES THE PLANT NEED?

An outstanding feature of "Minor ement" nutrition is the extremely small antity of the elements required. In fact. any of them are distinctly poisonous to ants if supplied in any considerable nount and this applies especially to the ur more recently discovered essential ements boron, manganese, copper and nc. It is easy to see how the necessity r these elements came to be overlooked r so long. Water culture solutions in y case are surprisingly dilute. Sachs' iginal solution, for instance, contained out 0.3% of dissolved salts, giving some 34 parts of potash (K O) and 0.14 parts nitrogen (N) per thousand. The naturly occurring soil solution is still more lute and it has been estimated to have a tal concentration of about 0.1% of ssolved substances.[11] Compared with ese figures the concentration of the Minor Elements" needs to be almost credibly low. Thus, in a recent ustralian paper [9] dealing with copper ficiency in oats and other plants, we read at considerable responses were obtained quantities of that element corresponding three millionths of a gram to the litre of lture solution — a concentration of 000003 parts per thousand. Notwithanding, a deficiency of copper is the cause a serious disease of oats and cereals nerally — usually called "reclamation sease." from its common occurrence on recently reclaimed peat soils — in Australia as well as in many parts of Europe. The observation that "reclamation disease" could be controlled by the application of copper sulphate was actually made several years before a conclusive proof of the essential nature of the element copper was forthcoming.

Some idea of the effectivenes of small quantities of the "Minor Elements" can also be gained from the applications necessary to cure deficiency symptoms in the field. One of the best known deficiency diseases in Britain is the disease of swede turnips known as "brown heart" or "raan."[5] This is particularly prevalent in Scotland and is cured by applications of 10-20 lbs. of borax (representing 1.15 to 2.30 lbs. of the element boron) per acre. This small quantity, to be applied evenly, must be mixed with dry soil or sand (or with other artificial fertilizers) so that the total amount reaches at least a hundredweight. It may be noted that, unlike the case of copper deficiency quoted above, the first field proof of the occurrence of boron deficiency was preceded by the proof of essentiality of the element, obtained from water culture experiments.

SOME EXAMPLES FROM TEA

Tea in Ceylon is not known to suffer from any deficiency diseases, although a few years ago the suggestion was made that *phloem necrosis* might be a disease of this kind — perhaps due to a deficiency of boron. However, this view has received no support from experiments that have been carried out and need no longer seriously be considered.[3] In other countries, the best known and most important deficiency disease of tea is the "yellows" disease, in Nyasaland, which is caused by a deficiency of sulphur. This disease was first reported in 1926, and the cause of it was not ascertained until Storey and Leach [13] published their account of it in 1933. A review of

this paper was published in the *Tea Quarterly* for that year (Vol. VI, pp. 121-127), so no further account of the symptoms of the disease need be given. Tea "yellows" is interesting as the first case of sulphur deficiency so far reported in the field: it is cured by the application of fertilizers containing sulphates, or by the direct addition of sulphur in quantities as low as 24 lbs. per acre. The acute sulphur shortage of the Nyasaland tea soils cannot yet be fully explained, and Storey and Leach are careful to point out that full symptoms of sulphur deficiency are developed only in the presence of an adequate supply of the other necessary inorganic nutrients.

Interest in deficiency diseases was recently increasing in Java, where serious symptoms of potash deficiency had become noticeable in certain districts. This was followed up by the Proefstation, West Java, and a full account, based on field observations and sand culture experiments, was published in 1940. This was also reviewed in the *Tea Quarterly* (Vol. XIII, pp. 139-145). The sand cultures were extended to cover certain of the recognised "Minor Elements" and in a later paper [4] various experimentally induced deficiency symptoms were described. Some of these are noted briefly below :—

Calcium.—Tea plants without calcium grow well at first but later develop pronounced symptoms, especially on the young leaves, of marginal yellowing, spreading inwards between the veins and eventually becoming brown or "scorched." A downward curl of the apex and margins of the leaf also occurs.

Magnesium.—Deficiency symptoms are noticeable only on the older leaves, which become very pale yellow, only the veins remaining green. There may also be a slight marginal scorch. The authors consider that this deficiency may occur in the field in Sumatra.

Sulphur.—Symptoms produced experimentally agree closely with the symptoms of "yellows," the plants remaining small with practically no flush, the leaves being mottled with yellow especially between the veins. Tea "yellows" is not considered likely to occur in the field in the Dutch East Indies.

THE AVAILABILITY OF THE "MINOR ELEMENTS" IN THE SOIL

The occurrence or otherwise of deficiency diseases cannot simply be predicted from the amount of the different "Minor Elements" known to occur in various soils, although in some cases such a general relationship can be shown to exist. Thus, in S. Ayrshire, Scotland, there is definite evidence that "brown heart" of swedes is less severe on those soils derived from rocks containing tourmaline, a mineral rich in boron [5] though in a very insoluble form. More commonly it is a question, not of the total amount, but of the "availability" of the element in question, as affected by certain other soil factors, the most important of which are (a) water relations, (b) pH and lime content, (c) soil micro-organisms. To a certain extent these three factors are interrelated, but it will be convenient to discuss them separately, in the ensuing paragraphs.

Rainfall, and the water relations of the soil, may affect the occurrence of deficiency diseases in two ways. Firstly, it is a matter of general observation that such diseases are more in evidence during drought and in dry seasons than with normal rainfall. Thus, severe attacks of "heart rot" of sugar beet (a boron deficiency disease corresponding to "brown heart" of swedes) may be expected when a rainy spring, which has led to vigorous growth and feeding of the young beet seedlings, is followed by a dry spell in summer, when the plant's absorption of soil nutrients receives a check.[6] Tea "yellows," also, is most in evidence

t the end of the dry season, after which here is usually a gradual improvement up o the end of the rains.[13] Secondly, the eaching effect of heavy rainfall needs to e taken into consideration. Deficiency liseases are usually more prominent on ght, sandy, soils than on the heavier nore retentive types, although actual ifferences in total nutrient content also lay their part here. The best example of "Minor Element" deficiency caused prinarily by leaching is that of "sand drown" f tobacco, which occurs in the United tates, Canada, and Nyasaland, and which ; due to a deficiency of magnesium.[8] ymptoms of this disease take the form of severe chlorosis in which only the veins etain their green colour, while the curing roperties of the leaf are also affected. Iagnesium is one of the commoner soil lements but it is also one of the most easily oluble and is quickly leached out of the urface layers. For this reason, it seems kely that actual deficiencies of this eleient in the soil may be much more widepread than is usually realized.[8]

The reaction of the soil and its lime ontent are among the most potent factors ffecting the availability of the minor ements. The two properties are so closely elated that it is not easy to separate one om the other. In most cases, however, ie actual occurrence of free calcium opears to be of more direct importance ian the degree of alkalinity with which is associated. Thus, deficiencies of boron, nc and iron are frequently induced by me, the elements though present in the il being rendered insoluble or otherwise navailable in the presence of this subance. Iron, especially, is a major constient of soils and it is doubtful whether ue iron deficiency is ever met with. Lack this element results invariably in chlorosis, or pallor due to deficient development of the normal green colour, and the relationship to lime is now so widely known that this condition is commonly spoken of as "lime-induced chlorosis." In Great Britain, there is a definite risk of this disease in planting fruit trees on certain calcareous soils.[8] As a preventative, the trees can be sprayed with iron sulphate solution, or this substance can be applied as a dressing on pruning cuts and other wounds. A more economic method of control is to grow cover crops under the trees. which, by their root action, are found to increase the availability of the iron already in the soil and hence counteract the harmful effect of lime. Still another method of increasing the supply of iron to the trees is by injection.

The importance of soil organic matter, and the micro-organisms which it supports, is receiving increasing emphasis in recent work on the deficiency diseases. The relationship is in many cases obscure and new interpretations of the observed effects are constantly being given. One or two examples will be sufficient here. One of best of these is the "reclamation disease" of cereals, already mentioned as induced by copper deficiency. This is usually associated with highly organic, peaty soils, and the beneficial effect of adding copper sulphate has been interpreted by various authorities as due to a transformation of the physical condition of the organic colloids leading to improved water relations, to precipitation or inactivation of an organic soil toxin or to the replacement of copper rendered unavailable by the action of anaerobic soil bacteria.[8] Copper is, however, truly essential to plant life so that the last mentioned alternative may prove to be the most feasible. A well substantiated case of this kind is provided by Gerret-

sen's recent work[6] on the "grey-speck" disease of oats, also prevalent on reclaimed moor or peat soils, but associated with a deficiency of manganese. According to Gerretsen, the manganese is rendered unavailable in the first place by precipitation in an insoluble form through the activity of certain bacteria. The symptoms of "grey-speck" are induced in the plant, not as a direct result of lack of manganese, but as a result of the increased susceptibility of the roots to the invasion of bacteria from the soil. They do not occur in the same manganese-deficient soils after sterilization, *i.e.*, in the absence of bacteria. Gerretsen also showed, however, that even under aseptic conditions, normal growth was impossible without a certain minimum quantity of manganese, so that this element can be regarded as truly essential for oats, (and other plants) in a direct sense as well as in the more complicated manner revealed by the occurrence of the "grey-speck" disease.

DIAGNOSIS AND CURE OF DEFICIENCY DISEASES

In the foregoing examples it has been assumed that a deficiency of a given element can be recognised by the characteristic symptoms produced in the plant and that the treatment to be followed consists of a simple manurial application of a compound containing the element in question to the soil. In the majority of cases, particularly with annual crops as cereals and "roots," this is the only feasible procedure. So many of the "Minor Elements" are poisonous in all but the smallest amounts that it is rarely advisable to apply them to the soil until definite evidence of their deficiency has been obtained. Recently, some attempts have been made to test the soil in advance by using it for the growth of some simple organism, such as an alga or fungus. that will quickly complete its life cycle in the laboratory. Ordinary methods of chemical analysis would be too tedious and besides, they would not necessarily distinguish between "total" and "available" amounts of the element in question in the same way that the growing plant will. As an example of a microbiological test of this sort is the use of the fungus *Aspergillus* (a common mould) to test the sufficiency of available copper, in connection with studies on "reclamation disease." [8] The fungus is grown on a synthetic nutritive medium containing no copper, to which is added a measured quantity of the soil to be tested, when it is found that a black colouration of the spores denotes a healthy soil (containing 1 in 400,000 parts by dry weight of available copper), while brown and brownish-yellow to yellow spores respectively denote varying degrees of copper deficiency and of liability to the disease.

With perennial crops, particularly fruit trees, where the number of plants per acre is relatively small, and the crop from each plant correspondingly valuable, it becomes more important to be able to diagnose a deficiency at the earliest possible stage, *i.e.*, before the yield has been impaired For this purpose, the method of direct *injection* into the plant is proving very valuable. Besides, by this procedure there is no danger of the element supplied being rendered unavailable, as it quite frequently is when added to the soil. Injection of woody plants has been known and practised for a very long time, for certain special purposes. In the fifteenth century, for instance, it was recorded that apples could be rendered poisonous by injecting arsenic into the trees at the time that the fruit was ripening. Other, more innocuous, ends have been served from time to time by injections of spices and honey to improve flavour in fruits, of dyes to colour flowers, and of preservatives to improve the injected timber.[10] From Sachs' time, injection for curative purposes became increasingly common,

specially the injection of iron salts to cure he ubiquitous iron-deficiency or lime-nduced chlorosis, already mentioned. The nodern use of injection methods for the iagnosis of mineral deficiency diseases has een largely worked out by Roach [10] and is co-workers at the East Malling fruit esearch station in Kent. Roach's methods epend on injecting the test liquid in such way that a limited part only of the plant eceives it. This may be a single branch, eaf, or even a part of a leaf. Any response hat is induced, such as a slight change in olour or texture of the injected part, will hen stand out sharply against the untreated emainder. Working in this way, unsus-ected mineral deficiencies have been diag-osed in a week, or even less, and the exist-nce of widespread and potentially serious alnutrition in the British fruit-growing ndustry has been demonstrated.

An interesting extension of the injec-on method has been to apply it to the jection of nutrient salts and other sub-ances including disinfectants designed to ave a specific effect in reducing the inci-ence of insect attack and of parasitic iseases. Further progress in this direction to be expected in the next few years and ome important changes in the practice of isease control in woody plants may be reshadowed.

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MANURING PROGRAMMES WITH RATIONED MANURES

T. EDEN

Since the publication of the note in the August, 1942, (Vol. XV, Part II) *Tea Quarterly* the fertilizer position has changed materially. Though, in general, supplies are more precarious, equitable distribution and regular delivery are assured by the voluntary rationing scheme and it is possible to plan programmes with a reasonable expectation of carrying them out.

Because supplies are greatly reduced, the first question that arises is whether to manure the whole acreage, or to concentrate on better yielding fields and thus give a higher dressing on these by sacrificing fields low in production This is not a question that can be answered by a formula for all circumstances but a few pointers may be of use in making decisions relevant to individual cases. The Institute's experiments have shown clearly the close connection between crop and wood growth so long as pruning and plucking systems are kept unchanged. With less manure both crop and wood must be expected to suffer deterioration and at a time when crop assumes temporarily a position of first importance, the decline in health of wood may be accentuated.

The accumulated results of the Institute's manurial experiments which will be published in greater detail later, show that regularly manured fields giving steady improvement in yield owe some of that improvement to more efficient utilization of manures. At the present time therefore there appears at first sight to be a valid argument for concentrating on the best fields at the expense of others not so good, but the extent to which this can be done is limited. In the case of very poor fields it might lead to damage that would be very hard to rectify without throwing these fields out of plucking. The fact remains that to follow a resting policy and sacrifice the basic yield of even poor fields would lead to a crop loss which could not be counterbalanced by the enhanced efficiency of manures on the best fields. To give an example based on actual data, 25 lb. of nitrogen is unlikely to contribute more than 200 lb. of immediate crop on the best fields. The circumstances are such that it is equally unlikely that by a policy of favouring good fields a margin of 25 lb. of nitrogen above the average could be assigned to them on the present scale of rationing. But it would be a very poor field indeed that did not give, unmanured, a basic yield of 200 lb. of tea per acre In general therefore the usual policy will be to use the manure available fairly uniformly over either the whole acreage or over all but a small part of it.

Of recent years the Institute has recommended an incremental series of doses as the pruning cycle has progressed The basis for this recommendation has lain in the fact that early in the cycle the bushes do not make efficient use of large doses. With the drastic reduction in quantities now obtaining, there is very little danger of overdosing even in the early stages, and as a matter of practical convenience incremental doses will be hard to fit in with the delivery of approximately equal quantities of manure at specified regular

ntervals. It will be better therefore to evert to a flat rate on the reasonable ssumption that at all stages except immeditely after pruning, the nutrients will be fficiently used. The proviso made in the revious article that on the longer cycles 3 years and over) the first dose can be elayed for about 12 months still holds.

The only divergence from a flat rate hat seems worth while adopting is one ssociated with fields with different lengths f pruning cycle. We have no precise data n the point and dogmatism would be ncalled for, but it is probable that a reducon in dose will lead in due course to a orresponding reduction in the length of runing cycle to which fields will effectively un. The longer dated fields may reasonbly therefore be given rather more nanure. The sort of difference envisaged s 5 lb. of nitrogen for every 12 months' ifference in cycle. This figure is quite mpiric and is based more on the general evel of manuring that the present ration ffords than on any conception of the actual needs of longer pruning cycles. By ay of illustration we may take an 800 acre state yielding an average of 750 lb. per cre. Such an estate would receive a itrogen ration of 25 lb. of nitrogen per cre. Assuming that 500 acres of the estate ere on a 3-year and 300 acres on a 4-year ycle, this scheme would give 23 lb. per cre on 3-year fields and 28 lb. of nitrogen er acre on 4-year fields. The method of alculation is shown in full below.

Acreage		
-year	500	Yield 750 lb. per acre
-year	300	N. allowance 25 lb. per acre.
otal	800	Total $N = 800 \times 25$
		$= 20{,}000$ lb.

he 4-year fields are to receive 5 lb. more han the 3-year fields : 5 is the 'incremental ifference.'

The general formula is :—

$$\text{Lower dose} = \frac{\text{Total N.} - \text{incremental diff} \times \text{acreage on higher dose}}{\text{Total acreage}}$$

Inserting the illustrative figures

$$\text{Lower dose} = \frac{20{,}000 - 5 \times 300}{800}$$

$$= \frac{18{,}500}{800} = 23.125$$

$\therefore$ Higher dose = Lower dose + 5 = 28.125

In terms of 500 lb. standard mixture containing 30 lb. N.

$$\text{3-year cycle needs } \frac{500 \times 23.125}{30} = 385 \text{ lb.}$$

$$\text{4-year cycle needs } \frac{500 \times 28.125}{30} = 470 \text{ lb.}$$

These are to the nearest 5 lb.

If there were three pruning cycle lengths, each differing from the next by equal time intervals, the appropriate formula for N. level would be

$$\text{Middle dose} = \frac{\text{Total N.—incremental diff. (acreage on highest} - \text{acreage of lowest dose)}}{\text{Total acreage}}$$

The results of the application of this formula to an actual example are as follows :—

Acreage		
2-year	200	Yield 750 lb. per acre
3-year	100	N allowance 25 lb. per acre
4-year	500	Total N. 20,000 lb.

Incremental difference 5 lb.

	lb. N. per acre	lb. per acre of mixture
2-year fields	18.125	300
3-year ,,	23.125	385
4-year ,,	28.125	470

With pruning cycles differing by only 6 months a difference of 3 lb. of nitrogen might be suitable. These formulae would be applicable, substituting the factor 3 for that of 5 in the examples chosen.

In order to maintain any regular programme of manuring it will be necessary to store manure from time to time. At a particular season of the year, delivery will be in excess of requirements and *vice versa.* Superintendents have not had any difficult weather conditions to contend with for storage since rationing started. Even in the coming months no deterioration of the manures need be anticipated. In normal times when mixtures were largely made up of inorganic salts a conditioner was added to prevent caking. The large amount of groundnut cake now in use is a much more adequate safeguard than is actually needed.

In conclusion, reference may be made to the use of fertilizer mixtures for food production areas. For all crops the best time to apply is when preparing the ground for sowing or planting of setts (in the case of root crops). For paddy lands this corresponds to the time of mudding and levelling after ploughing and green manuring.

NOTE ON THE AVAILABILITY OF NITROGEN IN GROUNDNUT CAKE AND COCONUT POONAC

J. G. SHRIKHANDE

INTRODUCTION

In view of the possibility that the import of groundnut cake from India may in future be seriously reduced owing to transport difficulties, it was considered desirable to examine the possibility of substituting coconut poonac for groundnut cake as a nitrogenous fertilizer. Groundnut cake is used largely to make up the shortage of nitrogen due to the depleted stocks of mineral nitrogenous fertilizers.

One of the primary values of oil cakes as fertilizers is the available nitrogen furnished by them during the process of decomposition. Their high nitrogen contents, like those of the legumes and other green manures, together with a rapid rate of mineralization justifies their use as nitrogenous fertilizers.

PRINCIPLES OF GENERAL DECOMPOSITION

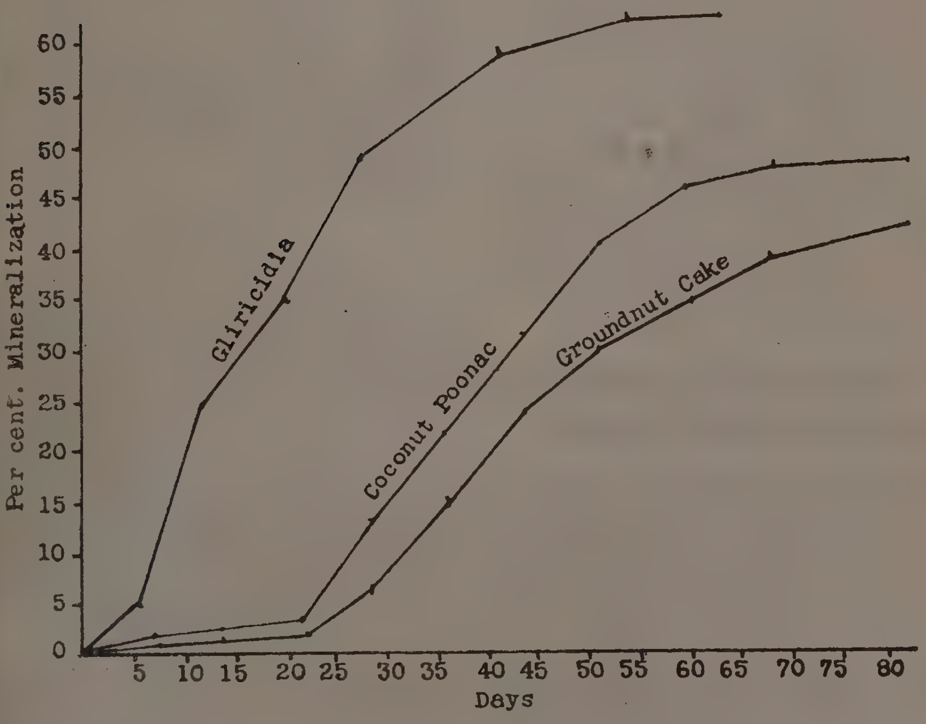
Most of the nitrogen added to the soil, when plant and animal residues such as dried bloodmeal, fish scraps and oil cakes are ploughed in, is in the form of proteins and their derivatives. All these substances have first to be broken down into simpler bodies before they can be of any use to the growing plant. This breaking-down process is carried on in the soil by micro-organisms and one of the final products is ammonia which often is further oxidized to nitrate. The nitrogen in ammonia or nitrate is available to plants; it may also be assimilated by the micro-organisms themselves if energy is available in the form of carbohydrates. The rate at which ammonia and nitrates are produced can be used as a measure of the rate at which the protein nitrogen of organic materials becomes available to growing plants.

RESULTS

The accompanying graph shows the te at which ammonia is produced from e two oil cakes For the sake of comrison the curve showing the rate of nmonification of Gliricidia leaves, which e commonly used as green manure, is so included in the graph. Because the iricidia leaves were young and succulent

materials produce the maximum amount of ammonia in about 8 to 9 weeks' time. But the point of interest to be noted is that, contrary to expectation, coconut poonac ammonified slightly more rapidly than the groundnut cake although the former is poorer in nitrogen It looks as though the protein nitrogen in coconut poonac is more readily available to the micro-organisms than that in groundnut cake.

Mineralization of Nitrogen in Oil Cakes & in Gliricidia



ey decomposed quickly and produced amonia more rapidly than the oil kes. Oil cakes are derived from seeds atured before crushing and consequently ve a structure different from young aves which makes them more resistant decomposition by micro-organisms. The ree curves indicate that all the three

The carbon-nitrogen ratio of an organic material merely indicates whether that material is suitable for direct incorporation into the soil ; it gives no indication of the rate at which the nitrogen will become available during decomposition. Since the value of a manure depends more on the quantity of plant food that is released from

it in an available form by the micro-organisms than on its total nutrient content, the experiment described here has not only demonstrated the value of coconut poonac as a suitable nitrogenous fertilizer but it has also shown the actual amount of nitrogen that becomes available to the plant during the process of decomposition. About 50 per cent of the total nitrogen was ammonified in 8 to 9 weeks. The process of ammonification is rapid in the earlier stages when the micro-organisms are growing rapidly at the expense of hemicelluloses and the soluble constituents like starches and sugars which provide a more easily available source of energy than cellulose When these constituents and about 40 per cent of cellulose are decomposed the micro-biological process slows down considerably and so affects the rate of mineralization of nitrogen. Such a stage is almost invariably reached in about 8 or 9 weeks' time.

THE RELATIVE VALUES OF GROUNDNUT CAKE AND COCONUT POONAC

It is customary to value a fertilizer in terms of unit values. Since nitrogen is the chief plant food in oil cakes it will be worth while comparing the two oil cakes investigated in terms of their unit values of nitrogen. To represent the cost of transport, Rs. 15 per ton has been added on to the cost of cakes before dividing by the percentage of nitrogen in order to determine the unit values of the two cakes in the following table :—

Material	% Nitrogen	Price per ton including Rs.15 for transport	Unit cost of nitrogen
		R. c.	R. c.
Groundnut cake	7·0	217-00	31-00
Coconut poonac	3·4	47-00	13-80

Although coconut poonac is cheaper than groundnut cake per unit it is the question of transport that stands in the way of using coconut cake in up-country districts. Owing to the restricted space available for transport of fertilizers to up-country tea estates only half the amount of nitrogen would reach estates if coconut poonac were to be used as a substitute for groundnut cake.

SUMMARY

It has been demonstrated that the rate of ammonification of coconut poonac during decomposition is almost similar to that of groundnut cake. Nearly 50 per cent of the total nitrogen becomes available in 8 to 9 weeks' period.

Although coconut poonac is cheaper than groundnut cake when compared in terms of unit values of nitrogen, its bulk and the limited space of transport militate against its use on up-country tea estates.

ACKNOWLEDGMENT

Thanks are due to Dr. C. H Gadd for a helpful criticism of the manuscript.

MAXIMUM PRODUCTION OF TEA AND LENGTH OF PRUNING CYCLES DURING EMERGENCY CONDITIONS

The question of the length of pruning ycles under present conditions was disussed at a Meeting of the Tea Research nstitute Experimental Sub-Committee held n the 10th April, 1943. The following ote represents the view of those present t the Meeting :—

Producers of tea in Ceylon have been old that 110 per cent of the estate's ssessed quota is required under the present mergency. Labour is short on the majoty of tea estates today ; not very short, ut a little, and is likely to get shorter.

The problem arises how to produce s near the desired quota with the availble labour, bearing in mind the high rates f wages now being paid, and shortage of rtificial manure. With the exception of ow-country areas, the general tendency as been to increase the length of pruning ycles in Mid and Up-country ; the reasons or so doing are well known, and need not e discussed in this note. In practice it as been found that, although the lengtheng of a cycle by 6 or 12 months has not many cases resulted in a decrease in onthly yields for that extra period, the xtra labour required to pluck areas on ngthened cycles is considerable.

A field in its first year from tipping n be plucked by, say, 4 to 6 pluckers r acre per round ; averages will be high and costs low. The number of pluckers required per acre rises as the age of the field from tipping increases. This is particularly noticeable when it becomes difficult for pluckers to force their way along the lines and reach the top flush of bushes which have grown high. Pluckers lose interest and adopt the attitude that 15 or 20 lb. earns them a name, so why take so much trouble to earn a few cents more on present high rates of pay ? However, on easily plucked fields, where high averages can be obtained, interest returns to the pluckers who go "all out" for a high daily intake.

For example an estate of 250 acres of tea (all in plucking) could be plucked 3 times monthly by 145 pluckers on 26 working days, provided the area can be covered by an average of 5 pluckers per acre. If the condition of the bushes required a general average of 10 pluckers per acre then double the labour force is required, or some of the acreage goes partially, or wholly, out of plucking.

The point at issue is that a maximum crop is required to be produced by a limited labour force ; to achieve this it appears evident that a reduction in the length of pruning cycles on many tea estates is necessary.

MINUTES OF A MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON HELD 6-10-42

Minutes of a Meeting of the Board of the Tea Research Institute of Ceylon held at the Ceylon Chamber of Commerce Rooms, Colombo, on Tuesday, 6th October, 1942, at 2-30 p.m.

Present.—Adigar T. B. Panabokke (Chairman), the Hon'ble the Financial Secretary (Mr. H. J. Huxham), the Chairman, Planters' Association of Ceylon (Mr. N. H. W. Dulling), the Chairman, Ceylon Estates Proprietary Association (Mr. R. Mann), Mr. J. D. Hoare, Major J. W. Oldfield, C.M.G., O.B.E., M.C. Messrs. J. C. Kelly, H. W. Gourlay, W. P. H. Dias and the Director, Tea Research Institute (Dr. R. V. Norris).

Letters regretting inability to attend were received from the Director of Agriculture, Messrs. R. G. Coombe, and G. K. Newton.

(1). Notice convening the meeting was read.

(2). The Minutes of the Meeting of the Board held on the 16th April, 1942, were confirmed.

3. MEMBERSHIP OF THE BOARD AND COMMITTEES

Board.—*(a)* Reported that Mr. D. E. Hamilton had vacated his seat on the Board resigning the Chairmanship of the Planters' Association of Ceylon and had been succeeded by Mr. N. H. W. Dulling with effect from the 17th July, 1942.

(b). Reported that Mr. C. H. Bois had vacated his seat on the Board on resigning from the Chairmanship of the Ceylon Estates Proprietary Association on the 26th August and had been succeeded by Mr. R. Mann.

The Chairman welcomed Mr. Dulling and Mr. Mann and the Board recorded a hearty vote of thanks to Mr. Hamilton and Mr. Bois for their services while serving on the Board.

Finance Committee.—Recorded that Mr. Dulling and Mr. Mann had become *ex-officio* Members of the Finance Committee from the date of joining the Board.

4. FINANCE

(a) Government Loan.—Reported that the payments due on the Government Loan, amounting to Rs. 75,315 were duly paid on the 29th September. This payment represents Rs. 35,701 interest charges and Rs. 39,614 repayment of the Capital.

(b) Institute's Accounts to 31st August, 1942.—These had been circulated to members. Reported that receipts from the cess were seriously reduced for a few months after the April Raid owing to the reduction in tea exports. The position had been restored in the past two months and the receipts from the cess to 31st August amounted to Rs. 229,270 as against Rs. 227,512 to the same date last year. Provided shipping facilities were not restricted, receipts from the cess for the year were now likely to exceed last year's figures.

Balance on Revenue Account to 31st ugust was Rs. 63,629 against Rs. 109,442 same date last year.

Estate Working Account at 31st ugust showed a debit balance of Rs. 9,973 ut at that date there was 51,000 lbs, of a not yet paid for.

Cash Position.—Of the sum shown on ted deposit (Rs. 80,015) Rs. 75,000 matured 24th September and was utilised for the an payment. At the end of September ere was cash in hand amounting to s. 114,000. Rs. 50,000 had since been aced on Fixed Deposit with the National ank of India against 1943 Loan payments.

It was suggested a further sum of s. 20,000 might be invested.

After discussion the Board agreed to vest this sum in 3 per cent Ceylon Government Home Defence Loan repayable at par June 1st, 1949.

5. ST. COOMBS ESTATE

(a) Visiting Agent's Report dated 16th ne, 1942.

This had been issued to members.

Crop.—Reported that crop to 30th ptember amounted to 154,967 lbs. (587 s. per acre) as against 143,408 for last ar. The estimate of 190,000 lbs. should exceeded.

Manures.—Reported that no manure d been received up to June. Since then tons had arrived as against normal nual requirements of about 80 tons.

Boundaries and Ravines.—An extra te of Rs. 100 as recommended by the siting Agent was sanctioned.

Illuk and Cooch.—An extra vote of s. 150 was sanctioned, particularly to an up ravines in No. 1 field.

Firewood.—The Director said the greatest difficulty had been experienced in obtaining firewood and it might be necessary to revert to the use of oil fuel.

The Director was instructed to increase, if possible, the capacity for oil fuel storage to two months' supply.

Prices.—Reported that under the arrangements now in force the price for St. Coombs crop would be 17.79d. or 98.83 cents per lb. gross.

Costs.—Reported that cost of production to 30th August, 1942 was 67.85 cents as against the estimate of 67.27 cents. Dearness Allowance amounted to 7.16 cents per pound and loss on rice and other foodstuffs to 1.79 cents.

(b) Food Production, St. Coombs.

A statement was tabled. In common with other estates in the wet zones the results, except with root crops, manioc and sweet potatoes, had been a total failure. Yields for roots were not yet available as the crops were not yet mature. Weather conditions had been the chief cause of failure, as it was impossible for grain crops to mature, but growth in the young tea clearings, originally patna land, was much worse than in pruned areas of old fields. Cowpea was badly attacked by root knot eelworm. All crops had suffered very severely from theft.

One or two members asked if better success was likely to be obtained with different seed strains of the crops tried. The Director said he did not think this was likely to make a material difference, the chief trouble had been climatic conditions which had not allowed any suitable period for crops to mature and ripen. He hoped better results might be obtained in the N. E. season.

6 SENIOR SCIENTIFIC STAFF.

Reported that the Director had been asked by the Planters' Association to act as the Organiser for a Voluntary Scheme of Fertiliser Rationing.

The Board confirmed the Director's action in agreeing to undertake the above function.

7. JUNIOR SCIENTIFIC AND SUB-ORDINATE STAFF

(a) Small Holdings Officer, Gampola.—The Board confirmed the appointment as from 15th July, 1942, of Mr. M. B. Boange in the temporary vacancy as Small-Holdings Officer, Gampola, due to Mr. Illankoon's absence on military service. Salary scale to be the normal scale of the appointment, *i.e.*, Rs. 200-20-400.

(b) Dearness Allowance — Junior and Subordinate Staff.—After discussion the Board decided to adopt with retrospective effect from 1st April the Dearness Allowance rates as laid down in C.E.P.A. Circular No. 11 of 1942-43.

(c) Increments.—The following salary increments were confirmed by the Board :—

Mr. H. B. Sreerangachar Rs. 20 per per mensem as from 15th July.

Mr. R. L. Illankoon Rs. 20 per mensem as from 1st October.

Mr. F. D. Tillekeratne Rs. 20 per mensem as from 15th September.

ANY OTHER BUSINESS

Petrol for members of the T. R. I. Board and Committees attending official T. R. I. Meetings.

The Director reported that the Petrol Controller was issuing extra petrol for members of the Rubber Research Scheme and Coconut Research Scheme Boards and Committees when attending official meetings of these bodies and he was applying for a similar concession to be made to the Tea Research Institute.

ROLAND V. NORRIS,
Secretary.

MINUTES OF A MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON HELD 18-12-42

Minutes of a Meeting of the Board of the Tea Research Institute of Ceylon held at the Ceylon Chamber of Commerce Rooms, Colombo, on Friday, December 18th, 1942, at 2-30 p.m.

Present.—Adigar T. B. Panabokke (Chairman), the Chairman, Planters' Association of Ceylon (Mr. Dulling), Messrs. R. G. Coombe, J. D. Hoare, J. C. Kelly, W. H. Gourlay, W P. H. Dias and Dr. R V. Norris (Director and Secretary).

Letters expressing inability to be present were received from the Acting Financial Secretary, the Acting Director of Agriculture, Major J. W. Oldfield, and Mr. G. K Newton.

(1). Notice convening the meeting was read

(2) Minutes of the Meeting of the ...rd held on the 6th October, 1942, were ...firmed.

3. MEMBERSHIP OF THE BOARD AND COMMITTEES

Board.—The Board received with much ...ret, the intimation of Mr. J. D. Hoare's ...gnation as a representative of the ...nters' Association of Ceylon, the resigna... to date as from 31st December, 1942.

A very cordial vote of thanks to Mr. ...re for his valuable services was ...orded.

It was noted that a nomination by the ...nters' Association of Ceylon of a ...cessor to Mr. Hoare would be made in ... course.

Finance Committee.—The appointment ... member to succeed Mr. Hoare on the ...ance Committee was deferred.

Estate and Experimental Sub-Commit...—Reported that Mr. F. J. Whitehead ... left Ceylon thus creating a vacancy on ... Committee. It was decided to invite ... E. de la Mare to take Mr. Whitehead's ...e and a very cordial vote of thanks to ... Whitehead for his invaluable services ... recorded.

4. CHAIRMANSHIP OF THE BOARD

The Chairman intimated that his pre... nomination as a Member of the Board ...ld expire on 1st February, 1943. He ...ght the time had now come for him to ...nquish the Chairmanship. Mr. Pana...ke said he had greatly appreciated the ...pliment paid to him in his election to ... Chair and he thanked the members of ... Board and the Director for the co-opera... extended to him. He reminded the Board that he had agreed to take the Chair for a limited period only and he would now be glad to be relieved as from the end of the year or as soon as the new Chairman could take over his duties.

Mr. R. G. Coombe referred to Mr. Panabokke's enthusiastic work on behalf of the Board and proposed that a very hearty vote of thanks to him be recorded. This was carried with acclamation.

On the motion of Mr. Dias seconded by the Chairman it was unanimously decided to invite Mr. G. K. Newton to take over the Chairmanship.

The Director said he understood that Mr. Newton would be willing to accept the appointment subject to the consent of his Firm.

5. FINANCE

(*i*). The Institute's Accounts to 31st October and 30th November were tabled and recorded. It was noted that Rs 75,000 representing payments due on the Government Loan in 1943 had been placed on fixed deposit with the National Bank of India.

(ii). Tea Research Institute and St. Coombs Estate Estimates for 1943.

- *(a)* Revised forecast of receipts and expenditure for 1942 and the similar forecast for 1943 were tabled and recorded.
- *(b) Research Estimates.*

Administration.—Vote 2, Travelling Expenses of the Board. Reported that the view of the Board on the question of the adequacy in existing circumstances of the present rate of travelling allowance had been sought by Circular dated 26th November, 1942.

The views expressed were divergent and the matter had been discussed by the Finance Committee. The latter considered mileage paid at 35 cents per mile was adequate but the rate of daily batta. Rs 12. was insufficient to cover a member's expenses. The Finance Committee recommended that the rate should be increased to Rs. 17.50.

On the proposal of Mr. Hoare seconded by Mr. Dulling the above recommendation was accepted.

Dearness Allowance.—It was decided as recommended by the Finance Committee that the amount on account of Dearness Allowance (drawn by Junior and Subordinate Staff on salaries not exceeding Rs. 200 per mensem) should be shown as a separate item under each major head of account

Mr. Hoare considered that the time had come when the question of a Dearness Allowance to the Institute's more highly paid staff should be examined.

After further discussion it was decided on the motion of Mr. Dulling supported by Mr. Dias to refer the whole question for examination by the following Committee :—

(1) The Chairman T. R. I., (2) Mr. J. C. Kelly, (3) Mr. Mann (or Mr. Gourlay if Mr. Mann is unable to serve) and (4) the Director. T. R. I.

Travelling Expenses, Senior Staff.—On the proposal of Mr. Hoare seconded by Mr. Dulling it was decided that the increased daily rate of batta as sanctioned for members of the Board should apply also to members of the Senior Staff when visiting Colombo, Kandy, or other centres where hotel bills had to be incurred. It was pointed out that the present rate, Rs 6.50 batta plus Rs. 2.50 lodging allowance was quite insufficient to cover hotel charges in present circumstances.

Subject to the above recommendation the Board on the motion of Mr. Coombe seconded by Mr. Dias unanimously accepted the Research Estimates for 1943 :—

Capital expenditure	Rs.	1,000
Revenue expenditure	,,	251 243

St. Coombs Estate Estimates 1943.—The Finance Committee recommended and the Board approved that Dearness Allowance of Subordinate Staff be shown separately from salaries and that Dearness Allowance of labourers should initially be shown under Vote 68 and subsequently allocated to individual votes involved.

Vote 66, Transport, was increased by Rs. 55

The Board approved the allocation of General Charges as to 95 per cent to Working Account and 5 per to Capital Account.

The Estate Estimates were then approved, *i.e.*

Working Account	Rs.	164,953	= 82.48	cents	per lb.
Capital Account	Rs.	17,273	= 8.64	,,	,,
Total	Rs.	182,226	= 91.12	,,	,,

(iii) T. R. I. Cess

It was reported that the Cess would be due to renewal in 1943. and the following Sub-Committee was appointed to consider the Institute's future financial policy and to report to the Board after the 1942 accounts had been made up :—

The Chairman, T. R. I., the Chairman P. A. of Ceylon, the Chairman, C. E. P. A Mr. W. P. H Dias. the Director, T. R. I.

6. ST. COOMBS ESTATE

(i) The Visiting Agent's report dated 2nd November 1942, was recorded

(ii) Reported that the balance of St. Coombs crop had been tendered tc Government under the terms of the Supplementary Contract for 1942

7. MINUTES OF THE MEETING OF THE ESTATE AND EXPERIMENTAL SUB-COMMITTEE HELD ON 21-11-1942

The above were recorded.

8. SENIOR SCIENTIFIC STAFF

(i) *Director.*—Reported that Dr. Norris ould be taking 10 days' leave in South dia in continuation of the Xmas holidays d that Dr. Gadd would act during his sence.

(ii) *Agricultural Chemist.*—Reported at Dr. Eden had been on sick leave for weeks in October/December following an eration for appendicitis. An increment Rs. 62.50 due to Dr. Eden with effect m 1st January, 1943 was sanctioned.

(iii) *Assistant Mycologist.*—After aring the report of the Mycologist and rector on Dr. Bond's work the agreement the above officer was renewed as from 8th February, 1943, on the same terms as the other Senior Staff officers. An increment of Rs. 50 per mensem due to Dr. Bond as from 8th February, 1943, was confirmed.

(iv) *Biochemist* (Captain J. Lamb).—An increment of Rs. 50 per mensem as from 12th February, 1943, was approved.

(v) *Physiological Botanist* (Major Tubbs).—An increment of Rs. 50 per mensem as from 12th February, 1943 was approved.

9. ANY OTHER BUSINESS

(i) *Publications.*—The Director referred to the difficulty in present circumstances in maintaining publication of the *Tea Quarterly*. It was possible the number of issues per annum might temporarily have to be reduced.

(ii) A vote of thanks was recorded to the Chamber of Commerce for the use of their rooms for the Board's meetings.

The meeting then concluded with a vote of thanks to the Chair.

ROLAND V. NORRIS,
Secretary.

The Tea Research Institute of Ceylon.

BOARD OF CONTROL

CONTENTS.

The publications of the Tea Research Institute will be sent, free of charge, to Superintendents of Ceylon tea estates, over 10 acres in extent, and to Estate Agencies dealing with Ceylon tea, if they register their names and addresses with *the Director, Tea Research Institute of Ceylon, St. Coombs, Talawakelle.*

Other persons can obtain the publications of the Institute on application to the Director, the subscription being Rupees fifteen per annum for persons resident in Ceylon or India, and £1-5-0 for those resident elsewhere. Single numbers of *The Tea Quarterly* can be obtained for Rs. 2-50 or 4s. In the case of Indian cheques four annas should be added to cover commission.